RESPONSE OF MALTING BARLEY CULTIVARS TO DIFFERENT LEVELS OF P' WITH AND WITHOUT N SUPPLEMENT, IN THE SOUTHERN NORTH ISLAND

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ABSTRACT

The results from trials held at three sites in the southern North Island to determine the resulting yield response and grain quality of three potential malting barley varieties to different levels and types of fertilization are reported.

It has been shown in previous trials that the use of nitrogen fertilizers significantly increases grain nitrogen, therefore decreasing malting quality. However, research on this aspect has been very limited in the North Island.

INTRODUCTION

The Canterbury (NZ) Malting Company is setting up a malting plant at Marton in the Rangitikei with production of malt from barley grown in the southern regions of the North Island.

The Company's activities and research have up till recently, been mainly confined to the South Island. For this reason, a research programme was initiated by the Malting Company in association with the Ministry of Agriculture and Fisheries.

In malting barley, quality is as important as yield. The trial reported in this paper was one of three separate trials set up to investigate the effects of fertilizer applications on the grain yield and quality of three malting barley cultivars.

EXPERIMENTAL

The trial was conducted on a Marton clay loam with a previous history of cereal crops. The soil had pH 5.6 and soil reserves of P15, K3, Ca7, and Mg32.

The remaining two experiments were conducted at Takapau and the other near Palmerston North.

A randomised block design with three replicates was used. Individual plots were 1.8m x 30m. The plots were sown at 15 cm row spacing and at a cereal seeding rate of 130 kg ha^{-1}. Potassium as potash (50 kg ha^{-1}). was applied basally to all plots prior to sowing. Three rates of phosphorous as "flowmaster super" (8% P) at 20, 40 and 80 kg P ha^{-1} were applied at sowing to Zephyr, Mata and Manapou barley. In addition 50 kilos of Nitrogen, as Nitrolime (26% N) was top-dressed at initial tillering on half the plots.

Yield measurements were made by header harvester with a swath width of 1.65m. Samples were collected from each plot after the weights had been recorded. Each sample was tested for the percentage of screenings and of grain nitrogen.

Screenings reflects the percentage of pinched grain in a given sample and were determined using a 6A (2.37 mm) screen.

Barley grain nitrogen was determined by the Kjeldahl method and expressed as percentage dry basis.

Grain yields were corrected to 13% moisture and expressed in kg ha^{-1}.

RESULTS

The yields of the three cultivars are presented in Table 1.

TABLE 1. Effects of nitrogen and phosphorous fertilizer on the grain yield of three malting barleys (kg ha^{-1}).

Rate kg ha^{-1}			Spring Barley Cultivar		
N	P		Mata	Zephyr	Manapou
0	0		5,004	4,557	4,574
0	20		4,861	4,495	4,579
0	40		4,764	4,629	4,469
0	80		5,021	4,436	4,603
		Mean	4,882	4,530	4,550
50	20		5,559	5,551	4,904
50	40		5,389	4,929	5,388
50	80		4,998	5,449	5,163
		Mean	5,315	5,309	5,151
Cultivar Mean Yield			5,085	4,863	4,881
LSD (0.05)			503	555	553

There was no significant difference in the mean yields of the three cultivars and they all tended to show a negative response to phosphorous.

Similar results were obtained at Palmerston North and Takapau. Furthermore, a review of several cereal trials carried out in the past by MAF in the southern North Island has shown inconsistency in grain yield responses to phosphorous (unpublished data).

All cultivars showed a significant increase in mean yields to the addition of nitrogen fertiliser.

In the Takapau trial, supplementary nitrogen

caused a reduction in yield for each cultivar, but the effect was not significant.

There were no significant differences among cultivars for barley grain nitrogen and screenings percentage. Consequently the response of these two factors to the fertiliser treatments have been averaged among cultivars and along with the yield responses are presented in Table 2.

The effect of fertilizer treatments on barley grain nitrogen and screenings percentage was highly significant and consistant within cultivars. The addition of nitrogen fertilizer alone resulted in this variation between treatment means.

TABLE 2. The effect of fertiliser treatment on yield barley grain nitrogen and screenings percentage.

Rate kg ha^{-1}			Yield	Screenings	Nitrogen
N	P		kg ha^{-1}	%	%
0	0		4,711	7	1.57
0	20		4,645	8	1.58
0	40		4,620	7	1.62
0	80		4,687	7	1.58
		Mean	4,650	7	1.59
50	20		5,338	15	1.75
50	40		5,235	13	1.73
50	80		5,203	13	1.73
		Mean	5,258	14	1.74

Similar results were obtained for the trial conducted at Masterton. Mean screenings for the control block was 15%. Mean screenings for nitrogen at 12.5% kg ha^{-1} were 17% and for nitrogen at 25 kg ha^{-1} 28%.

Where supplementary nitrogen fertiliser was applied at the Takapau trial, a mean screenings of 27% was obtained. The mean screenings for the control was 20%. The overall high percentage screenings that occurred at Takapau was a result of the moisture stress conditions which prevailed at grain filling.

DISCUSSION

Screening percentage is an effective measure of how well the barley grain has filled. The more plump the grain, the lower (with preferred malting varieties) is the grain nitrogen percentage (Table 2).

Grain nitrogen is a useful index of barley quality as there is a highly significant negative correlation between it and malt extract. For Zephyr samples tested from the Manawatu and Rangitikei a correlation coefficient r = -.767, giving a regression of -.108% total fine and coarse grind extracts on 0.1%N was obtained. Hogan *et al.*, (1962) studying Proctor barley found significant correlations between either coarse or fine grind extracts of malt and barley total nitrogen. Thus the lower the percentage grain nitrogen the higher the potential recoverable extract and therefore, the more desirable is the barley for malting.

For feed barley, there would be a small net return for the plots which received nitrogen fertiliser. However, under a malting barley payout system, the price paid varies according to the percentage screenings within a line.

Prior to last season, the price paid for a malting barley line by the Malting Company in Canterbury was calculated by deducting $1.40 per tonne from the premium price for every one percent increase in screenings above 5%. Taking a premium price of $105 and using the data in Table 2, the following net returns are obtained (Table 3).

TABLE 3. Estimated costs and returns per hectare.

Costs		Returns	
kg ha^{-1}	$	Treatment	Net Return
20P	11	Control	481
40P	22	50N - 20 P	455
50N	24	50N - 40P	445

From these results, it can be seen that the application of nitrogen fertiliser has not been economical under the environmental and cultural conditions that occurred.

Present indications are that poor filling is most frequently associated with one or more of four factors, namely disease, excessive nitrogen fertiliser use, trace element deficiencies and water stress (Bayles 1977). This latter effect presumably occurred at Takapau.

Results from other fertilizer trials in southern North Island have also shown that grain filling frequently deteriorates with applications of nitrogen.

The underlying reason for the adverse effect of excessive nitrogen fertiliser on grain quality is not clearly understood, but it seems that several factors are important. Firstly, by increasing tiller density and leafiness, excessive nitrogen reduces the light intensity within the crop thereby reducing the photosynthetic rate per unit leaf area for each fertile tiller. Secondly available soil water supplies may be exhausted more rapidly by high nitrogen crops, which may then suffer more readily from water stress. The photosynthetic efficiency of high nitrogen crops is sometimes further impaired by increased susceptibility to foliar disease and lodging (Bayles, 1977).

CONCLUSIONS

There is clearly no single answer to the complex problem of shrivelled grain, since a wide range of factors interact to determine grain quality. However, the results from these trials indicate that even where a significant yield increase has been obtained from applications of nitrogenous fertiliser, the overall effect was uneconomic due to the reduced quality of the barley grain for malting.

The results from one years trials can not be conclusive and further work in this area is needed to gain a clearer understanding of the effects of environmental and husbandry factors which should then point to ways in which high yielding quality grain can be achieved. Therefore there is a need at present for more careful and tactful use of fertilisers by growers on barley crops contracted for malting.

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